

OFFICE MEMORANDUM



MICHIGAN
DEPARTMENT OF STATE HIGHWAYS

964
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To: L. T. Oehler
Engineer of Research

From: L. F. Holbrook

Subject: Michigan's Accident Experience with Glass Bead License Plate Reflectorization. Research Project 75 TI-286. Research Report No. R-964.

Michigan license plates were glass-bead reflectorized starting with the 1971 plate year under the assumption that they would reduce rear-end collisions. This study attempts a very brief evaluation of the safety benefit assumption and a cost effectiveness comparison with another highway safety program.

Measure Statistics

An extremely important aspect in program evaluation is the selection of a measure statistic which is sensitive to the concept under examination. Sensitivity is sharpened by making the statistic immune to irrelevant variables found in various degrees of association with the variable of interest. For these reasons, the following statistics were developed for reflectorization program evaluation:

1. Percent night, rear-end fatal collisions of all rear-end collisions.
2. Percent of night accidents which are rear-end collisions.
3. Percent night, rear-end fatal collisions of all rear-end fatal collisions.
- 4.- 9. Same as above except for personal injury and property damage accidents.

These statistics, however, would be sensitive not only to collision reduction due to reflectorized license plates, but they would be sensitive to other factors such as the following:

1. A drop in fatal, personal injury, or property damage collisions resulting from
 - a. Decreased average vehicle speed.
 - b. Improved automobile safety equipment such as belts, harnesses, padding, etc.

2. A drop in rear-end collisions resulting from improved automobile rear-end lighting, street lighting, head rests, etc.
3. A drop in night collisions resulting from increased urbanization with its associated street and ambient lighting, less nighttime travel, or changes in the time period during which nighttime fell. The latter effect could be quite important considering Michigan's recent history with Daylight Saving Time.

In order to eliminate as many as possible of the above extraneous influences the three statistics were "corrected" by the following associated factors:

1. Average day, rear-end fatalities as a percentage of day, rear-end collisions.*
2. Average day, rear-end fatal collisions as a percentage of day fatal collisions.
3. Average night, non-rear-end fatal collisions as a percentage of non-rear-end fatal collisions.

With these multiplicative corrections it was hoped that all 1968 to 1973 general trends in rear-end collisions, collision severity, and nighttime collision incidence would be eliminated. Since license plate reflectorization could be expected to influence only night, rear-end collisions in each severity class, the effects of this factor on the measure statistics would remain unchanged.

The Data

Because of reporting form changes and other technical limitations, only accident data for the three-year period preceding reflectorization (1968 to 1970 inclusive) and the three-year period following reflectorization (1971 to 1973 inclusive) were used. These data were composed of all reported accidents in Michigan (excluding City of Detroit, personal injury, and property damage accidents). Fatal, personal injury, and property damage collisions were grouped according to the categories specified by the measure statistics and their correction factors. The corrected statistics were then computed for each year and shown graphically.

Results

Since all three statistics showed the same yearly pattern, only No. 2 (per-

* Since the accident data period available for the desired calculations was 1966 to 1973 inclusive, all averages were over the three-year period preceding and the three-year period following reflectorization.

cent of night accidents which are rear-end collisions) is presented in Figure 1. Examination of the pre and post reflectorization periods shows that there is an extremely small drop in fatal collisions after the introduction of reflectorization. There are larger comparable period drops for personal injury and property damage categories. Table 1 gives these average drops for each collision severity category and license plate period.

TABLE 1
AVERAGE PERCENT OF NIGHT ACCIDENTS
WHICH ARE REAR-END COLLISIONS

	Fatal	Personal Injury	Property Damage
Average 1968 to 1970	8.31	26.29	20.47
Average 1971 to 1973	7.39	24.26	18.56
Change	0.92	2.03	1.91
Estimated Collision Reduction (number per year)	4	213	439

Also shown in Table 1 is the estimated night, rear-end collision difference between the two periods computed on a yearly basis. If the difference between the periods is due to reflectorization (a point to be discussed later) then from these data one could estimate that four fatal collisions would be prevented by bead reflectorization each year. On the other hand, 213 and 439 personal injury and property damage collisions, respectively, would also be prevented.

Combining all severity categories, we find that the change in the periods is statistically significant. This is not at all unusual for averages based on very large samples of field data. This is especially the case when samples are drawn from different time periods as in the present study. Statistical significance testing assumes that the samples are selected at random, which, of course could not be done in this study since reflectorized plates were made available only for the last three years of the study period. These years may, and probably do, have other important variables associated with them that affect accident types and distributions (e.g., increased proportion of modern vehicles having large highly visible tail-lights). Randomization would have allowed the picking of accidents from all years for both the reflectorized and the non-reflectorized group. This would tend to "cancel out" or equalize the effects of extraneous variables. Large deviations can be expected whenever data are sampled in a non-random fashion. In fact, in the non-reflectorized period, night, rear-end collisions significantly differ for the 1968 to 1969, and 1969 to 1970 yearly comparison where no variable is known which could explain the differences. Potential

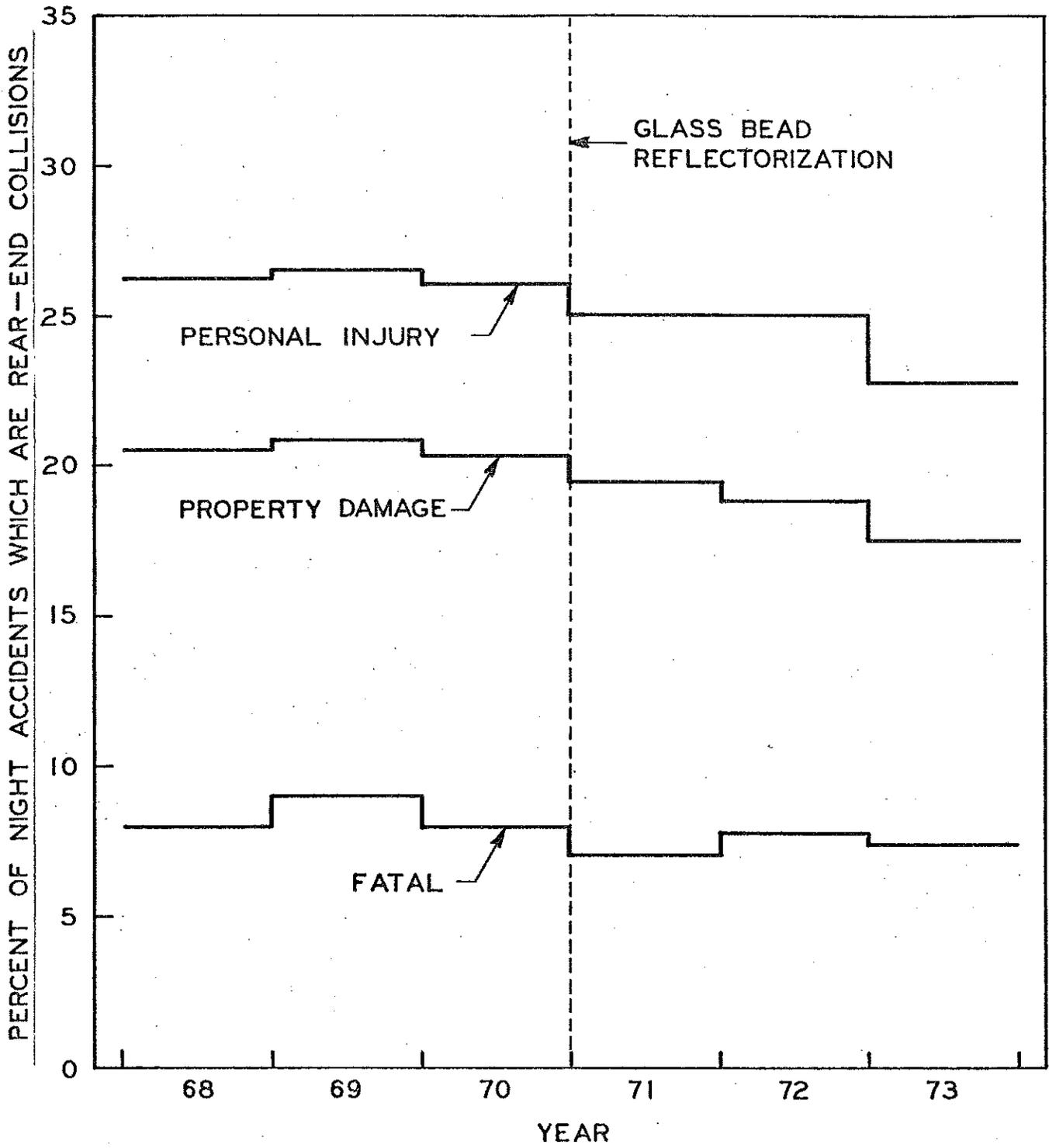


Figure 1. Yearly pattern of night, rear-end collisions.

variables which could bias comparisons in the absence of randomization could be:

1. Changes in reporting procedures.
2. Increased incidence of other types of accidents such as "fixed object," etc.
3. Changes in automobile rear-end lighting.
4. Increased availability and usage of restraining seat belts and harnesses affecting severity more in rear-end collisions than in other types.

Cost Effectiveness

This is the most important section of the study -- for any candidate accident prevention program must compete, on a dollar basis, with established alternatives. Unless there are compelling social reasons, it would be irresponsible to prefer a safety program which on an investment basis was less effective than proven alternatives.

Assuming that the observed change in night, rear-end collisions is caused by reflectorization of license plates, it is important to compare the presumed effectiveness of this program with that of other well understood alternatives. For this purpose, the high-accident intersection surface treatment program has been selected.

Recent research by the Laboratory* has shown quantitatively the benefits in collision reduction resulting from intersection resurfacing.

As an example of these benefits, the following conditions are assumed typical for an intersection chosen for resurfacing.

Skid Number Before Resurfacing	30
Resurfacing Cost	\$5,000.00
Yearly Dry Surface Accidents**	30
Length of Benefit from Resurfacing	5 years

From what is known about wet accident reduction following intersection re-

* Holbrook, L. F., "Specification of Wet Accident Incidence from Wetness Exposure and Skid Number," submitted for presentation at the Second International Skid Prevention Conference, University Park, Pa.

** Many intersections experience 2, 3, 4 times this dry accident incidence.

surfacing, it is estimated that for the above conditions, three accidents per year or 15 accidents over five years (the benefit life) could, on the average, be prevented with this program.

Assuming that the reflectorization program prevents 656 (4 + 213 + 439) collisions per year, this would be equivalent to the reduction afforded by resurfacing $656/15 = 44$ intersections of the type chosen in this example. A \$5,000 cost per intersection times 44 intersections equals a \$220,000 equivalent cost for the same benefit with the surface treatment program. Assuming 10,000,000 license plates in Michigan (not including the City of Detroit*) we find that this amounts to a cost of 2.2 cents per plate. In other words, if reflectorization is assumed to be 100 percent responsible for the collision reduction observed for the time periods in this study, it is not competitive with the intersection resurfacing program if it costs more than about 2.20 cents per plate. It should be stressed that the assumptions of plate benefit have been made despite statistical reservations herein discussed.

In order to be rational, any other plate reflectorization program would have to produce benefits in proportion to the glass bead program. For example, if reflectorization costs 22.5 cents per plate, to be comparable with resurfacing it would have to produce 10 times the accident reduction assumed for glass-beaded plates. This would amount to a reduction of 6,560 which is more than the typical yearly total of night, rear-end collisions experienced in the state. Quite obviously, no program could be this cost effective in reducing nighttime rear-end collisions.

* Based on 1974 vehicle registrations.

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